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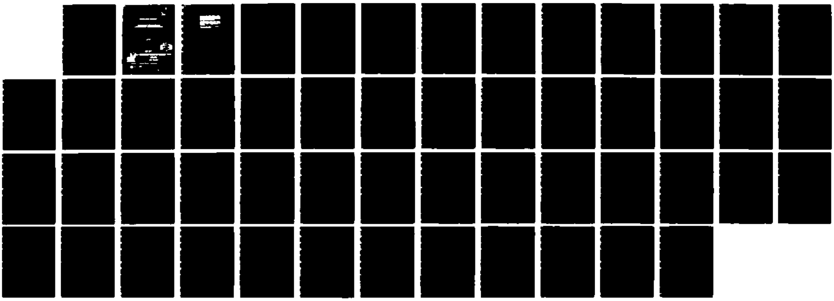

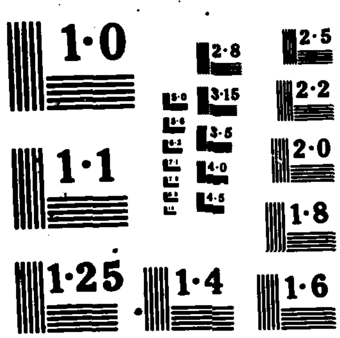

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AD-A168 353

TECHNICAL REPORT ARRAD-TR-86001

SYSTEM SAFETY PROCEDURES FOR NONDEVELOPMENT ITEM (NDI) ACQUISITIONS

SAMI HOXHA

MAY 1986

US ARMY ARMAMENT MUNITIONS & CHEMICAL COMMAND

ARMAMENT R&D CENTER

U.S. ARMY ARMAMENT RESEARCH AND DEVELOPMENT CENTER

SAFETY OFFICE

DOVER, NEW JERSEY

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This report provides guidelines in the application of a tailored MIL-STD-882 System Safety Program approach during nondevelopment item (NDI) acquisitions. It outlines the steps in NDI acquisition and defines the system safety required at each step. The report also provides examples of safety checklists for market surveillance/investigation and safety requirements for specifications and solicitation documents.

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FOREWORD

On 5-7 June 1985, the AMC Action Committee for System Safety had their semi-annual meeting at Natick Research and Development Center. A key agenda item was the Army's non-development item (NDI) acquisition process and possible techniques to assure that system safety becomes an integral part of the process. This report is a by-product of the discussions.

CONTENTS

INTRODUCTION

"Greater reliance on NDI types of acquisition is the wave of the future" (ref 1). It is important that the safety community realize this fact and come to grips with it. The means to be able to fit into the nondevelopment item (NDI) process without compromising safety must be developed. This requires both a determined effort on the part of the safety engineer to be involved early in the process and also the development of guidelines that clearly define the system safety role in the NDI acquisition process. "NDI presents special safety problems due to the lack of testing, use in environment for which it is not designed, and lack of compliance with normally accepted Army safety standards. In cases where Army standards are not met, a conscious decision must be made whether or not the increased risk is acceptable" ~~(ref 1)~~. Based on this statement, NDI may not meet the safety standards that Army equipment developed through a normal acquisition process are required to meet; however, that does not mean safety has to be compromised. We also must not deviate from the objective of system safety, which is integral to its definition "...optimize safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system life cycle" (ref 2). To accomplish this, a comprehensive System Safety Program Plan must be developed that will adequately interface with the NDI acquisition process. The guidelines presented in this report are an optimum approach for a typical process; however, just as "each NDI acquisition will be tailored to the peculiarities of the requirement, the particular technology or industry involved, and the ever-present resource and time constraints" (ref 1), the system Safety Program Plan will need to be tailored accordingly.

DISCUSSION

The best way to develop the system safety program guidelines for an NDI acquisition process is to define the role of system safety in the various phases of the NDI acquisition process. An overview of this acquisition process (ref 3) is presented in the following paragraphs and in figures 1 through 3, with the system safety role highlighted.

Concept Exploration Phase (fig. 1)

Operational and Organization (O&O) Plan

The NDI acquisition process starts with the establishment of a materiel requirement by TRADOC in the form of an O&O plan. Safety requirements envisioned by TRADOC are incorporated in the plan.

Preliminary Determination

AMC reviews the O&O plan and assesses technical feasibility. Integral to this assessment is a preliminary determination that NDI is, or is not, a viable option. As part of the technical feasibility assessment, there is also a safety assessment that considers the NDI option and is obtained through a preliminary hazard analysis developed in-house by the Safety Office or by the appropriate development laboratory. This analysis is a rough outline identifying potential hazards and safety concerns based on historical data, functional description, and limited technical data available on the alternatives.

Independent Evaluation Plan (IEP)

The next step in this phase is the development of IEPs for the market investigation by both development (TECOM or AMSAA) and operational (TRADOC or OTEA) independent evaluators. The IEPs address issues, identify data requirements/sources, state the approach for independent evaluation, specify the analytical plan, and identify program constraints. The IEPs must include specific safety issues and identify safety data requirements which can be derived from the preliminary hazard analysis and the O&O plan.

Market Surveillance and Investigation

Market surveillance is accomplished primarily by AMC laboratories or R&D centers prior to O&O plan approval and provides a knowledge base for market investigations (MI). A market investigation is the process of gathering information in response to a documented requirement (e.g., O&O plan, draft LOA or ROC). It is a central activity in the concept exploration phase leading toward a milestone I decision as to whether or not to select an NDI acquisition strategy. AMC leads the MI in coordination with TRADOC and an independent evaluator. It is very important for safety to be an integral part of the market surveillance and market investigation and that necessary safety data are gathered to assist in the overall system assessment. A safety checklist should be developed and used as part of the market surveillance investigation. This checklist should address the following generic, as well as specific, safety issues (app A):

1. Generic

    What hazard analyses have been conducted?

    What are the historical accident data?

    What is the profile of commercial use?

    What were the safety design requirements used?

What safety testing has been conducted? To what standards and by whom?

What were the test results? Who evaluated them?

Has the item been evaluated by an accredited U.S. laboratory or test agency? What were the results?

Are there any unique safety features? If any, describe.

Are there any restrictions? If so, what are they?

Are there any known safety and health hazards that have not been eliminated or controlled?

2. Specific (This will depend on the type of system being evaluated.)

Is there a Department of Transportation (DOT) Hazard Classification? If yes, what is it?

Is there a Nuclear Regulatory Commission (NRC) license for the manufacture and selling of the product?

Are the explosives safety qualified to U.S. standards?

Does the fuze comply with MIL-STD-1316C?

What is the safe separation distance?

Are there surface danger zone data available?

Are the explosives and materials compatible, and what tests have been done to demonstrate compatibility? To what standards?

What is the blast overpressure level?

What is the noise level? Where was it measured with respect to the operator?

Are there any toxic producing substances? What is their level?

Are there any potential carcinogenics?

Are there any exposed high voltages?

Are there any radio frequency (RF) emitters? What is their power density level?

Are there any rotating parts in the system? How are they guarded?

Do any components/surfaces exceed 140°F? Are they guarded?

Does the system have any sharp edges or pointed surfaces?

Independent Evaluation Report (IER)

Using all available data (e.g., prior test information, prior experience, the market surveillance, mission area analysis, O&O plan, and performance characteristics of the approved requirement), the evaluators prepare an IEP prior to the market investigation and an IER afterwards. Data are gathered and analyzed prior to milestone decision review (MDR) I and each MDR thereafter. These IERs provide a basis for determining if a commercially available system can fill the need, and the extent of and justification for any further testing required. Safety requirements and issues identified in the IEP will be assessed in the IER.

Acquisition Strategy

If the results of the market investigation indicate that an NDI solution is feasible, AMC initiates development of an NDI acquisition strategy that should have a section that clearly defines the system safety effort. It is essential that the system safety organization supporting the acquisition be closely involved in the development of the NDI acquisition strategy. A system safety program plan shall be developed to thoroughly document the system safety effort for the particular NDI acquisition strategy selected. This plan can be attached as an addendum.

Support Documentation

The NDI decision is made at the milestone I decision review. In preparation for this review, numerous actions must be completed (ref 3). System safety needs to be an integral element of the majority of these actions; however, the primary areas of safety involvement are as follows:

- Safety and health data sheet
- Interim health hazard assessment
- Test integration working group
- Test and evaluation master plan

- Systems concept paper

- Risk assessment

The safety and health data sheet provides the safety position for the milestone I review and this report is based on the data accumulated through the hazard analysis, IERs, and the market investigation. In support of the safety and health data sheet, an interim health hazard assessment performed by the Surgeon General's office will be needed. In addition, system safety has to be addressed in the system concept paper (SCP). This will occur if the system safety effort has been defined in the NDI acquisition strategy. Requirement documents must include specific safety requirements. Transportability approval has to address hazard classification for shipment of hazardous material. Safety has to be represented at the test integration working group (TIWG) and safety testing has to be clearly defined and included in the test and evaluation master plan (TEMP). TEMP and acquisition strategy are approved at milestone I; therefore, safety requirements included in these documents become part of the NDI process and have to be addressed by the project managers.

Milestone I Decision

The program decision authority conducts a milestone I review with the documents listed in chapter III of reference 3 to obtain approval to pursue an NDI acquisition. Safety position is directly presented by the safety and health data sheet, but must be fully integrated into the other program documents.

Acquisition Documentation Phase (fig. 2)

Acquisition Plan

Once an NDI solution is authorized, AMC prepares an acquisition plan to support contracting efforts. The system safety program plan developed as part of the acquisition strategy has to be made part of the acquisition plan.

Specification

When the acquisition plan and integrated logistic support plan (ILSP) are approved, AMC, in conjunction with TRADOC, prepares a formal specification or functional purchase description for the solicitation. These documents must have specific safety design and verification requirements (app B).

The Milestone III Decision

AMC conducts a final review (milestone III) prior to the release of the solicitation package which:

1. Approves the acquisition strategy to support production and deployment phase.

2. Approves and type classifies the system (standard or generic).

If approved, the decision authority issues a system acquisition decision memorandum revalidating the acquisition strategy and releasing the solicitation for purchase. Safety position again is documented in the safety and health data sheet.

Solicitation Package

The solicitation package is issued by AMC. System safety requirements and documentation must be included in the solicitation package. The following list of data may be required (app C):

- Historical accident/incident data
- Safety design standards to which the product conforms (i.e., NFPA, NEC, AMSTE, ANSI, etc.)
- Profile of commercial use
- Results of acceptance test
- Contractor tests performed and the results
- Operating and support hazard analysis
- Other hazard analyses
- Safety assessment report
- Hazard classification data
- Surface danger zone data
- NRC license (contractor)
- Materiel safety data sheets/hazardous component safety data statements
- EOD and emergency procedures

- Demil procedures

- Safety verification/certification

Proposal Evaluation

Contractor proposals are evaluated using prespecified evaluation criteria in accordance with the Federal Acquisition Regulations (FAR). Evaluation criteria shall include safety issues. A preaward survey is required for hazardous item contracts to evaluate contractor's ability to meet safety requirements. Safety personnel shall be part of the evaluation team.

Source Selection

Contract award goes to the contractor who best satisfies all requirements. At this time, the TC is definitized if limited to generic at milestone III. Safety position is provided through the safety and health data sheet.

Production and Deployment Phase (fig. 3)

Hardware Availability

Hardware availability date is established by AMC planners.

Product Evaluation

During this period, new equipment training (NET) commences and may be performed by the contractor. At this time and prior to materiel release, a variety of safety data must be evaluated, developed, and verified to support a safety position for the materiel release. Safety actions that need to be completed at this point are:

- Evaluate safety implications of NET

- Review technical manuals to ensure necessary safety procedures and warnings are incorporated

- Review all safety documentation delivered as part of contract requirements (i.e., operating and support hazard analysis, safety assessments reports, etc.)

- Verify operating and support hazard analysis

- Review safety test results
- Obtain final hazard classification
- Develop a final surface danger zone
- Obtain safety certification (IER)
- Obtain DA authorization for radioactive items
- Obtain NRC license
- Establish EOD procedures
- Obtain final health hazard assessment report
- Obtain AMC fuze review board position
- Obtain safety of flight release

Materiel Release

The materiel fielding plan (MFP) is finalized and the materiel fielding agreement completed jointly by AMC and the ultimate user. Materiel release is accomplished in accordance with AMCR 700-34. The Safety Office is a voting member of the Materiel Release Board and the safety position is based on the results of the completed safety actions listed above. A safety evaluation is incorporated in the materiel release package.

Fielding

At this point, the system safety effort is minimal. During first article testing, there is safety testing, if required, in the performance specification (i.e., proof test, 40-ft drop, jolt, jumble, transportation/vibration, etc.). When the follow-on evaluation is conducted, there should be specific safety issues identified for evaluation. In keeping with the concept of Life Cycle System Safety there is a need to implement a tracking system to monitor field experience with the item. The Safety Office will also need to coordinate with the user the transfer of safety information and provide support.

CONCLUSIONS

1. The acquisition alternatives available cover a full spectrum from traditional "heel-to-toe" development to classic "off-the-shelf" nondevelopment items (NDI). Tailored acquisitions employing varying degrees of NDI are between the

two extremes. Although NDI offers several major benefits, it also presents some major problems. One of these is system safety. Under the NDI concept, we are asked to accept an item that we had no control over developing and testing, an item that may be acceptable for commercial use, and incorporate it into the combat environment with the same effectiveness. This is to be accomplished in a very short time since the NDI objective is to shorten the acquisition cycle. All these aspects place a considerable strain on the safety community to meet its objective. However, the safety of the soldier cannot be compromised.

2. The NDI acquisition process is a quick and unorthodox approach which precludes the application of our traditional MIL-STD-882 system safety program approach. However, it does not preclude application of a tailored MIL-STD-882 approach. In keeping with this concept, guidelines for an optimum approach for a typical NDI process are presented. It also allows tailoring to complement particular NDI processes and the individual safety engineer will decide what works best for his particular program.

3. Contrary to orthodox development efforts, in a majority of cases, NDI acquisition effectively precludes the Army from obtaining sufficiently complete and detailed safety engineering evaluations and assessments from the prime contractor. As a consequence, much of the safety effort required during NDI acquisition must be accomplished by in-house assets or through special consultative-type contracts awarded to safety engineering firms early in the NDI acquisition cycle (i.e., at time of preliminary determination). This fact places special pressure on the Army Safety Program to provide adequate, clear, and concise safety engineering support to the NDI acquisition manager. The guidance provided by this report will help to ensure that both the project and safety engineers are aware of the need to fully integrate system safety engineering into the NDI Acquisition Program.

RECOMMENDATION

It is recommended that HQ, AMC adopt the guidelines presented in this report for use as standard operating procedures in the application of system safety to NDI acquisition.

Fig. 1 OVERVIEW OF NDI ACQUISITION PROCESS AND SYSTEM SAFETY PROCESS

CONCEPT EXPLORATION PHASE

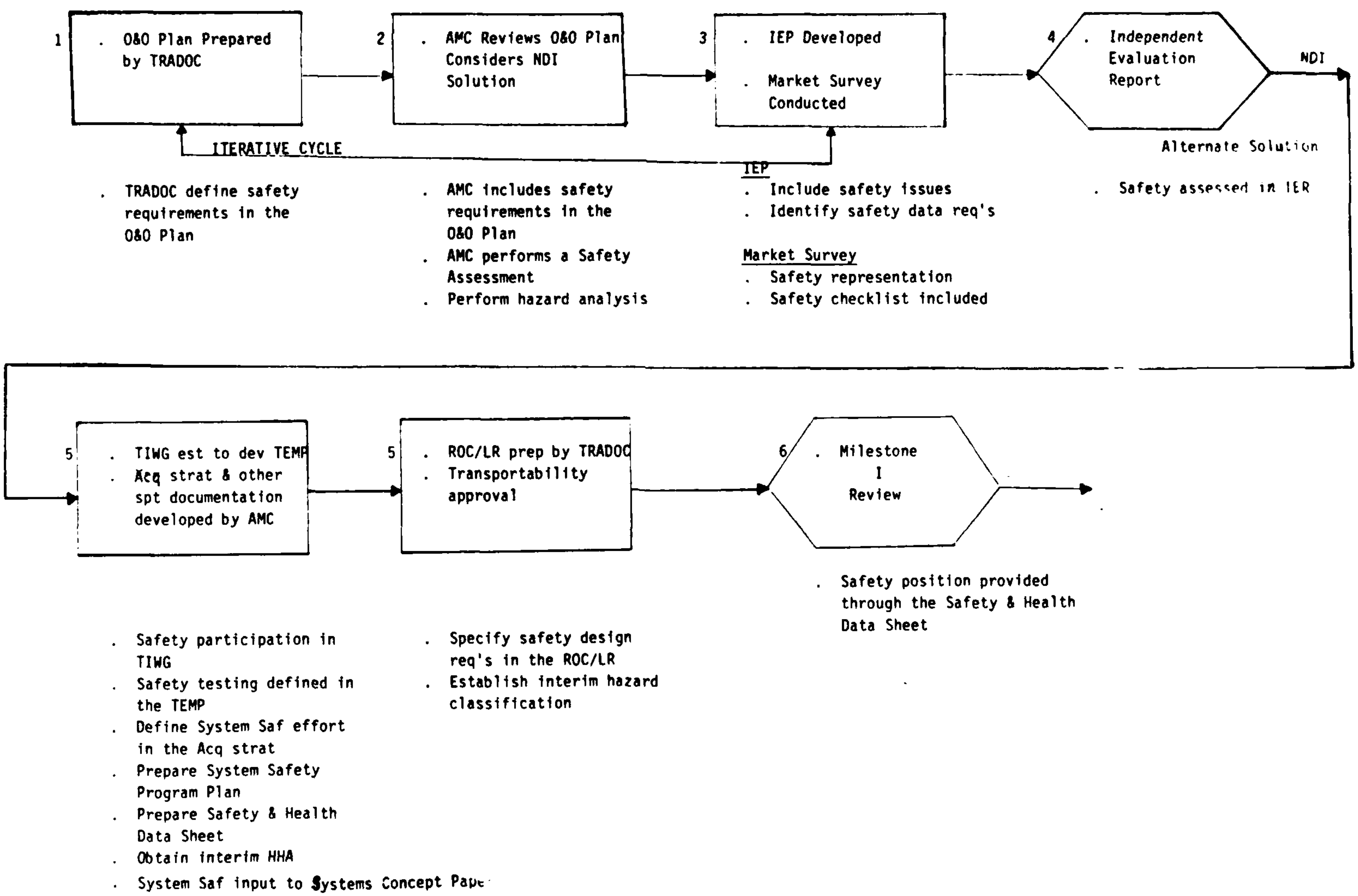

Figure 1. Concept exploration phase

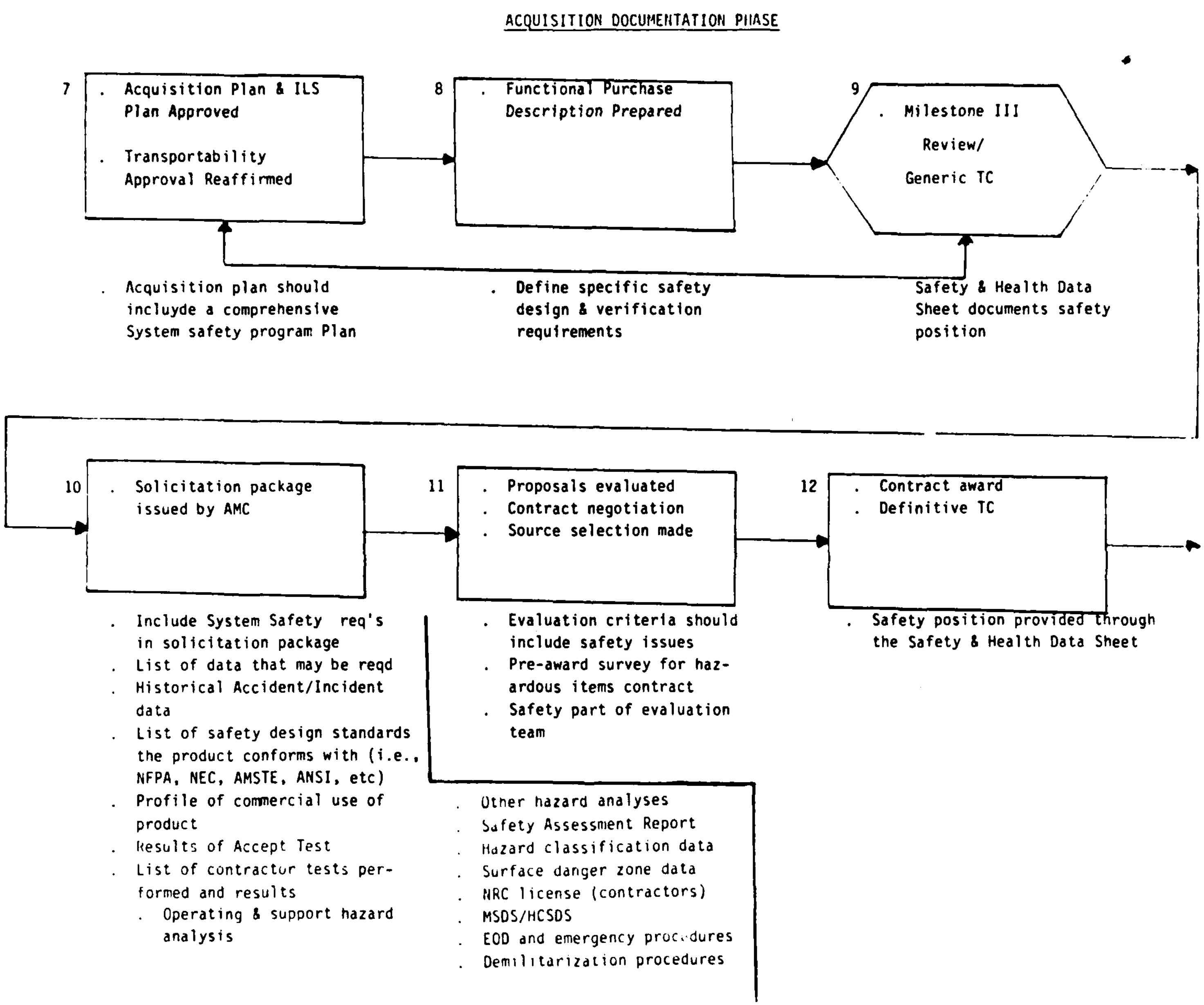

Figure 2. Acquisition documentation phase

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- Hardware Avail Date Established
- New Equipment Training Begins

15

- Materiel Fielding Plan Completed
- Float Established
- Materiel Release

18

- FAT
- First Unit Equipped
- IOC
- FOE

- Prior to Materiel Release the following safety data must be developed , evaluated, or verified:
- Safety implications of NET
- Review TM's to ensure warnings are included
- Review all safety doc delivered as part of contract (i.e., O&SHA, SAR, etc)
- Verify O&SHA
- Review safety test results
- Obtain Final Hazard Class
- Develop final surface danger zone
- Obtain Safety certification (ITR)
- Obtain DA Auth f/Radioactive items

- Obtain NRC license
- Establish EOD procedures
- Obtain final HHAR
- Obtain AMC Fuze Review Board position
- Obtain safety of flight release

- Safety Office is a voting member of the Materiel Release Board
- Safety evaluation to be included in the Materiel Release package

- FAT. Safety testing per performance spec
- FOE. Specific safety issues identified for evaluation
- Monitor safety field experience

Figure 3. Production and deployment phase

REFERENCES

1. AMC Pam 70-7/TRADOC Pam 70-7, AMC Nondevelopment Item (NDI) Acquisition, 1984.

2. AMCR 700-34, Materiel Release for Issue, 15 April 1985.

3. MIL STD-882, System Safety Program Requirements, 30 March 1984.

APPENDIX A

SAMPLE MARKET INVESTIGATION SAFETY QUESTIONS

1. <u>Safety</u>

a. Are guards or shields provided for rotating or high temperature parts of the MPU?

b. Is the operator's platform and steps (if required) equipped with or fabricated of antiskid material?

c. Are handholds or safety rails provided?

d. Is the MPU equipped with warning and caution plates?

e. Is any special training required for the operator or mechanic to ensure safe operation?

f. Are any hazardous fumes or gases created at work area during mixing and pumping or slurry?

g. Does the item comply with all safety requirements of OSHA?

h. What are the second-level measurements?

i. Does noise level comply with OSHA requirements for a normal eight-hour work day? If no, is sound suppression equipment available as standard or optional equipment?

j. Can the operator safely operate the MPU while it is loaded on a truck?

k. To what federal, militlary, and/or commercial standards for sfety has the MPU been designed?

l. How is the blasting agent <u>recovered</u> or <u>disposed</u> of during <u>cleaning</u> of the MPU?

m. Is the MPU equipped with safety shutdown circuits?

n. Are flanged connections (instead of threaded ones) used wherever possible to facilitate maintenance and repair of equipment contaminated with DBA?

o. Is the equipment designed to eliminate cracks, crevices, exposed threads, and socket head fasteners to prevent accumulation of dried DBA?

p. Are internal welds continuous and polished smooth?

q. Do electrical systems meet OSHA or NEC, whichever is more restrictive?

r. Is a hazard analysis of the MPU in its operating environment provided by the supplier?

2. <u>Human Factors</u>

a. Are operating controls within easy reach and marked as to their use and function?

b. Are there any human factor problems associated with the following items?

(1) Steps or ladders

(2) Handholds

(3) External or protruding components

(4) Work space

c. Is the MPU capable of being operated, maintained and resupplied by personnel wearing NBC and/or cold weather protective clothing?

d. To what federal, military and/or commercial standards for human factors has the MPU been designed?

3. <u>Environmental Conditions</u>

a. Can the MPU be <u>operated</u> in temperatures from minus 25^{o}F to plus 120^{o}F?

b. Can the MPU be <u>safely stored</u> in temperatures of minus 28^{o}F to plus

$160^{o}F$?

c. What are the temperature limits (hot and cold) for satisfactory operation of the MPU/slurry?

APPENDIX B

SAMPLE SPECIFICATION REQUIREMENTS

SAMPLE A:

SAFETY DESIGN REQUIREMENTS

3.2 Safety. This specification contains requirements which may necessitate the handling of hazardous materials and result in the manufacture of a hazardous item. It is emphasized that all applicable safety rules, procedures, and regulatory requirements be strictly followed during the handling, processing, and testing of the completed item and related hazardous materials.

3.2.1 The supplier shall obtain NATO or US Department of Defense (DOD) and Department of Transportation (DOT) hazard classification and authorization to ship, which will be furnished to the Contracting Officer prior to the delivery of any hazardous items.

3.2.2. The supplier shall certify that any change in packaging from that described in the TDP will not affect hazard classifications.

3.2.3 Packaging, marking, and labeling shall comply with 49 CFR, Hazardous Materials Regulations, DOT.

3.2.4 Hazardous components will be identified to the Contracting Officer. Only energetic material acceptable for DOD will be utilized.

3.2.5 Demilitarization and disposal methods will be specified by the supplier.

SAFETY VERIFICATION REQUIREMENTS

4.4.14 Safety.

4.4.14.1 Throughout all acceptance tests, data will be recorded related to safety, health hazard and human factors.

4.4.14.2 Muzzle blast overpressure will be measured in accordance with standard HEL/TECOM test procedures.

SAFETY DESIGN REQUIREMENTS

3.4.1.5 Premature Burst. There shall be no premature burst in the gun bore or in the first 300 meters of flight.

3.4.1.6 Metal Parts Separation. There shall be no metal parts separation in the gun bore or in flight.

3.4.2 Safety Performance. The cartridge shall be able to withstand the following safety conditions.

3.4.2.1 Hot-Dry Cycle. The cartridge shall withstand a 7-day temperature cycle and subsequently be launch and flight safe when tested as specified in 4.5.3.1.

3.4.2.2 Unit Pack Puddle Test. The unit pack shall protect the cartridge when exposed to a complete water immersion to a depth of at least 12 inches lasting for 30 minutes. After being immersed, the cartridge shall not produce low or erratic velocities when tested as specified in 4.5.3.2.

3.4.2.3 Metal Part Security. The projectile body assembly shall reveal no evidence of failure when tested at excess pressure as specified in 4.5.3.3. Projectile body failures shall be:

a. Projectile body deformation attributable to non-compliance with drawing and specification requirements.

b. Loss or breakup of any component, in the mortar tube or in flight.

3.4.2.4 Sequential Rough Handling. The cartridge shall withstand rough handling procedures and all visually serviceable rounds will subsequently be launch and flight safe when tested as specified in 4.5.3.4. Obviously damaged test rounds shall be safe for handling and disposal (by standard EOD procedures).

3.4.2.5 Forty-foot Drop. The cartridge shall withstand a 40 ft packaged drop without detonation or burning when tested as specified in 4.5.3.5. The test cartridge shall be safe for handling and disposal (by standard EOD procedures).

4.4.4 Testing.

4.4.4.1 Ballistic Verification. The cartridges shall be observed for the following characteristics:

a. Misfires, Major defect (see 3.4.1.2)

b. Duds, Major defects (see 3.4.1.3)

c. Short rounds, Critical defect (see 3.4.1.4)

d. Premature burst, Critical defect (see 3.4.1.5

e. Metal parts separation, Special defect (see 3.4.1.6)

f. Range and precision, major defect (see 3.4.1.1)

Testing shall be as specified in 4.5.1.

4.4.4.1.1 One hundred and thirty-five random sample cartridges shall be selected from each lot for this test. The lot shall be rejected if:

a. Two or more misfires occur

b. Five or more duds occur

c. One or more short rounds occur

d. One or more premature burst(s) occur

e. One or more metal parts separation occur

f. Range and precision requirements are not met, at ambient temperature

4.4.4.2 Safety Verification. Cartridges shall be randomly selected for these tests. The individual test breakdown is as follows:

No. of Rds.	Test	Test Method Para.
12	Hot/Dry Cycle	4.5.3.1
10	Unit Pack Puddle Test	4.5.3.2
10	Metal Parts Security	4.5.3.3
80	Sequential Rough Handling	4.5.3.4
8	Forty Foot Drop	4.5.3.5
120		

The acceptance/rejection criteria shall be in accordance with the applicable TECOM TOP. The safety criteria will be considered met if, for that particular treatment, no defects that may affect safety are encountered. Any ammunition characteristics that are hazardous will be identified. Hazards will be categorized according to MIL-STD-882B, and the hazardous ammunition characteristic will be classified as a deficiency or shortcoming according to TOP 1-1-012.

SAMPLE B:

Safety. All rotating or reciprocating parts and other parts subject to high operational temperatures that are of such a nature or are so located as to be a hazard to operating personnel, shall be guarded or insulated to the extent necessary to eliminate the hazard. Protective devices shall not impair the operating functions. All walking surfaces shall be provided with an anti-skid surface. All platforms, steps and handholds shall permit unhampered and nonhazardous entrance and exit.

Noise Limits. The noise limits at the operator's station and surrounding occupied areas shall not exceed 85 dBA when tested IAW the "Noise Level Testing Requirements".

Noise Level Testing Requirements. The equipment noise level at the operator's station and all immediate occupied areas shall not exceed 85 dBA when tested IAW the requirements of Para 5.1 of MIL-STD-1474. The data shall include dBA levels and octave band pressure levels taken at the operator's station and all occassionally occupied positions. If these data exceed the limits specified in Category D, Table 2 of MIL-STD-1474, the contractor shall reduce the noise level or provide documentation verifying that compliance is either technically or economicaly unfeasible.

Exhaust System. The exhaust system shall be located such that the entrance of exhaust gases into the ooperator position shall be minimized under all conditions of operation. Exhaust and other discharges from the equipment shall be directed so that they do not endanger personnel or obstruct the view of the operator. Location of the tailpipe shall prevent heating of tires, distrubance of road dust, and any clogging by mud or water. The muffler shall be located not closer than 2 feet from the fuel tank. Where this is not possible fuel shielding will be used to protect the tank from any part of the exhaust system within 1 foot of the tank and insulator and shielding elsewhere.

Fuel System. Fuel tanks shall be located in a manner which will not allow spills or overflows to run onto the engine, exhaust, or electrical equipment. Fuel lines shall be adequately supported and shall be protected against mechanical damage. Construction and mounting shall be such that neither vibration nor tightening of mounted devices will cause leaks to develop. The bottom of the fuel tank and its supporting members shall not be lower than the lowest adjacent part of the chassis or body. The filler cap shall not protrude from the body of the system.

Electrical Equipment. Electrical equipment shall meet the criteria set forth in MIL-STD-454, Requirement 1, for the design and development of militlary electronic equipment. In addition, all exposed parts which are electrically energized shall be insulated, fully enclosed, or guarded. Components shall be located so as not to be adversely affected by engine heat. All electrical

components shall be water resistant and designed to that their normal functioning will not be impaired by entrance of water during heavy rains, from road splash, from condensation, or from water spray resulting from other causes. All non current carrying metal parts shall be grounded.

Wiring. Wiring shall be secured in compact harnesses and attached to frame members with insulated clamps at close intervals to ensure a neat and orderly cable run. Cables and wires shall not be spliced at any point throughout the length of their runs. Wiring shall not be attached to panels or other components that require removal during maintenance, except for actual electrical connects to components. Electrical isolators shall be used between all wiring and metal components to prevent abrasive action to wire insulation. Wiring shall be color coded or numbered for easy identification and shall be consistent throughout the system.

Battery Boxes and Units. Batteries shall be securely held in place on carrier trays by means of removable locking devices and shall be protected against engine and exhaust heat. Battery terminals shall be provided with guards to prevent accidental shorting. The battery circuit shall be provided with a reverse current device to protect the voltage regulator from damage when the batteries are connected in reverse polarity.

Toxicity. Whenever possible, an alternate nontoxic material shall be chosen. When this is not possible the toxic materials contained within the system shall be controlled such that they do not present a hazard to the user under any

condition. Material safety IAW FED-STD-313, one copy of which shall be forwarded to the qualifying activity of this specification.

Workmanship. All parts shall be clean, free from rust, toolmarks, pits and other injurious defects. External surfaces shall be free of burrs, sharp edges and corners except where sharp edges or corners are required or where they are not detrimental to safety.

Toxicological Data and Formulations Inspection. The contractor shall furnish to the contracting activity the toxicological data and formulations required to evaluate the safety of the material for the proposed use.

Noise Level Test. Noise levels shall be measured in accordance with MIL-STD-1474 requirements and reported in the format indicated by MIL-STD-1474, Figure 7. As a minimum, noise levels shall be measured when equipment is operating under full load, MIL-STD-1474, paragraph 5.1.2.1.4 contours shall be taken at not fewer than 12 equal (horizontal) arc increments, one increment shall include data from the noisiest position, additionally, the noise level at the typical operating position shall be provided as dB(A) level. Failure to comply with MIL-STD-1474 provisions shall constitute failure of this test.

SAMPLE C:

REQUIREMENTS

3.5.2 Safety. The simulator shall comply with the following requirements after conditioning at the temperatures at para 3.5.1.

3.5.2.1 Heat Flux Density. The heat flux density shall not exceed __ cal/cm^2/sec ___ feet from simulator.

3.5.2.2 Fragmentation. Upon functioning, the simulator will not propel hazardous fragments or burning debris beyond ___ feet when tested as specified in para 4.5.3.5.

3.5.2.3 RF Susceptibility (or Electromagnetic Radiation). The simulator shall not function when tested as specified in para 4.5.8.11.

3.5.2.4 Electrostatic Discharge. The simulator shall not function when tested as specified in para 4.5.8.12.

3.5.2.5 Lightning. The simulator shall not function when tested as specified in para 4.5.8.13.

3.5.3 Explosive Hazard Classification. When tested during First Article Testing as specified in para 4.5.10, the simulator in its shipping and storage

packaging shall meet the requirements of the following classifications:

DOD Hazard Classification: 1.3

DOD Compatibility Group: G

DOT Hazard Classification: Class C Explosives

DOT Marking: Cartridges, Practice Ammunition

3.5.3.1 Net Explosive Weight. The total of all explosives, propellants, pyrotechnics and other (hazardous/energetic) materials shall not exceed ___ grams per simulator.

3.6 Environmental Conditions.

3.6.1 Vibration. The simulators, when packaged, shall not fire when subjected to vibration as specified in 4.5.8.1. After subjection to such vibration (and additional testing as indicated for First Article Tests), the devices shall show no signs of damage, shall be safe to handle and fire, and shall meet the performance requirements when test fired as specified in para 4.5.8.1.

3.6.2 Shock. The simulators, when packaged, shall not fire when subjected to shocks as specified in 4.5.8.4. After subjection to such shocks (and additional testing as indicated for First Article Tests, or Quality Conformance Inspection), the devices shall show no signs of damage, shall be safe to handle and fire, and shall meet the performance requirements when test fired as specified in para 4.5.8.4.

3.6.3 Seven-foot Drop. The simulators, when packaged, shall not fire when subjected to drops from a height of seven feet as specified in 4.5.8.6. After being subjected to such drops (and additional testing as indicated for First Article Tests), the devices shall show no signs of damage, shall be safe to handle and fire, and shall meet the performance requirements when test fired as specified in para 4.5.8.6.

3.6.4 Loose Cargo Transport. The simulators, when packaged shall not fire when subjected to loose cargo transport as specified in 4.5.8.8. After being subjected to the loose cargo transport (and additional testing as indicated for First Article Tests, or Quality Conformance Inspection), the devices shall show no signs of damage, shall be safe to handle and fire, and shall meet the performance requirements when test fired as specified in para 4.5.8.8.

3.6.5 Five-foot Drop. The unpackaged simulators shall not fire when dropped from a height of five feet as specified in 4.5.8.5. After being subjected to such a drop (and additional testing as indicated for First Article Tests or Quality Conformance Inspection), the devices shall be safe to handle and fire, and shall meet the performance requirements when test fired.

3.6.6 Forty-foot Drop. The simulators, when packaged shall not fire when dropped from a height of forty feet as specified in 4.5.8.7 and shall be safe to handle and dispose of.

3.6.7 Low Temperature. The simulators shall be capable of withstanding low temperature conditions as specified in 4.5.8.2 and shall meet the performance requirements when test fired.

3.6.8 High Temperature. The simulators shall be capable of withstanding high temperature conditions as specified in 4.5.8.3 and shall meet the performance requirements when test fired.

3.6.9 Leakage Test. The simulators, when packaged shall be capable of withstanding exposure to the leakage test as specified in 4.5.6. Leakage shall constitute a failure.

3.6.10 Leak Test. The simulator shall not leak when tested as specified in 4.5.7. Leakage shall constitute a failure.

3.6.11 Jumble. The simulator shall comply with the following requirements when tested as specified in 4.5.5.

3.6.11.1 The simulator shall not function during test.

3.6.11.2 There shall be no powder leakage.

3.6.11.3 The simulator components shall not separate during test.

4.5.3.1 Sound Characteristics. The test item and sound detector shall be positioned 6 $\pm$ 0.2 feet above the ground. The sound detector shall be placed 64 $\pm$ 1 feet from the test fixture along the direction of the blast. Sound measurements shall be taken at right angle to the direction of the blast using test method ____________________. Observation shall be made for compliance with requirements of para 3.5.1.1.

4.5.3.4 Heat Flux Density. The heat flux density shall be determined at ___ feet using test method ____________________. Observation shall be made for compliance with requirements of para 3.5.2.1.

4.5.3.5 Fragmentation Characteristic. Fragmentation and burning debris effects shall be evaluated using test method ____________________. Observation shall be made for compliance with requirements of para 3.5.2.2.

4.5.5 Jumble. The simulator assemblies shall be tested in accordance with procedures specified in MIL-STD-331, Test 102.2, except that the duration of the test shall be a minimum of 20 minutes. The assemblies and equipment shall be observed and inspected for compliance with 3.6.11. (Destructive Test)

4.5.6 Leakage Test. The test shall be performed in accordance with the procedure specified in MIL-P-116H, para 4.4.3.1 and 4.4.3.2 or 4.4.3.6. After the test, the seal shall be examined for compliance with the applicable

requirements as specified in para 3.6.9. (Non-Destructive Test)

4.5.7 Leak Test. The simulator shall be placed in a sealed test chamber and the chamber pressurized to 3 to 5 psig dry air for 15 seconds. Observe pressure gage for pressure drop. Any test item that exhibits a pressure drop shall be classified defective as specified in para 3.6.10. (Non-Destructive Test)

4.5.8 Environmental Tests. Environmental testing shall be conducted to determine compliance with the requirements of 3.6.

4.5.8.1 Vibration. This test shall be conducted in accordance with Method 514, MIL-STD-810, Test Procedure I, Test Condition I-3.2.1, Figures 514.3-1, 514.3-2, 514.3-3 (Vertical, Transverse and Longitudinal axis) for 120 minutes (equal to 2000 miles) in each axis. Observation shall be made for compliance with requirement 3.6.1.

4.5.8.2 Low Temperature. This test shall be conducted in accordance with Method 502.2, Procedure I of MIL-STD-810, except that the simulator shall be exposed to a temperature of minus 25 $\pm$ 5^{O}F until thermal stabilization is reached and maintained for a period of 6 hours (minimum). Then the simulator shall be test fired within a period of time not to exceed 5 minutes. Observation shall be made for compliance with requirement 3.6.7.

4.5.8.3 High Temperature. This test shall be conducted in accordance with

Method 501.2, Procedure I of MIL-STD-810 except that the simulators shall be exposed to a temperature of 125 $\pm$ 5^{O}F until thermal stabilization is reached, and maintained at that temperature for a period of 6 hours (minimum). Then the simulator shall be test fired within a period of time not to exceed 5 minutes. Observation shall be made for compliance with requirement 3.6.8.

4.5.8.4 Shock. This test shall be conducted in accordance with Method 516.3 Procedure IV of MIL-STD-810, Table 516.3-II. Use column with Largest Dimension, 91 cm and over, and Weight, under 45.4 KG (100 lbs). The 26 drops shall be divided among four boxes (two at minus 25 $\pm$ 5^{O}F, two boxes at +125 $\pm$ 5^{O}F). The packaged simulators shall be observed for compliance with requirement 3.6.2.

4.5.8.5 Five-foot Drop Test. The simulators shall be fired after a drop from 5 feet on to a 2-inch thick steel plate embedded in concrete. During First Article Testing, each item shall be dropped once for each orientation listed below at hot temperature (six per orientation, total of 30 items); followed by the same at cold temperature (six per orientation, total of 30 items). During Quality Conformance Inspection, one (1) item shall be dropped once for each orientation (total 5 items per orientation). Observation shall be made for compliance with requirement 3.6.5.

a. Bottom down.

b. Top down.

c. Side down.

d. Bottom down at 45° angle.

e. Top down at 45° angle.

4.5.8.6 Seven-foot Drop. The packaged simulators shall be dropped from a height of 7 feet (measured to the bottom of the package) on to a 2-inch thick steel plate embedded in concrete in the orientations below:

a. One drop on side and one drop on end; at hot temperature.

b. One drop on top and one drop on bottom at 45° angle; at hot temperature.

c. One drop with bottom down and one drop on top edge at 45° angle; at cold temperature.

d. One drop on side (opposite (a) side) and one drop on one end (opposite (a) side); at cold temperature.

The packaged simulators shall be observed for compliance with requirement 3.6.3.

4.5.8.7 Forty-foot Drop Test. This test shall be conducted in accordance with Test 103 of MIL-STD-331. The packaged simulators shall be dropped in the following positions: One drop with bottom down at minus $25^{\circ}F$, one drop with end down at $125^{\circ}F$. A new simulator package shall be used for each drop. The

simulator shall be observed for compliance with requirement 3.6.6. (Destructive Test)

4.5.8.8 Loose Cargo. This test shall be conducted in accordance with Method 514.3 of MIL-STD-810, Test Procedure II, Test Conditions I-3.2.3. (One box positioned on its base and one box positioned on its end, at hot and cold temperature for First Article only). The simulators shall be observed for compliance with requirement 3.6.4.

4.5.8.9 Temperature-Humidity. The packaged simulators shall be subjected to a 14-day temperature humidity test according to MIL-STD-331, Test 105.1. Observation shall be made for compliance with requirement 3.6.12.

4.5.8.10 Temperature-Cycling. The packaged items shall be conditioned Cold (minus 25 $\pm$ 5°F), Ambient (+70°F), and Hot (+125°F), as specified in MIL-STD-810, Method 503.2, Procedure I, Table 503.2-1. Hot Dry Ambient Temperature items response will be 125 $\pm$ 5°F. Observation shall be made for compliance with requirement 3.6.13.

4.5.8.11 Radio Frequency Susceptibility. The simulator bare, packaged and in its firing device shall not function when exposed to RF radiation IAW TM-TS-85-1 from the Electromag. Eval Br, Test and Instr. Div, Tech Support Dir, ARDC.

4.5.8.12 Electrostatic Discharge. The simulator bare, packaged, and in its

firing device shall not function when exposed to ESD using Procedure ________ of Test 126 of MIL-STD-331A.

4.5.8.13 Lightning. The simulator bare, packaged and in its firing device shall not function when exposed to Near Strike lightning using Procedure _____ of MIL-STD-1757A.

4.5.10 Explosive Hazard Classification. Testing of simulators in their shipping and storage packaging shall be performed IAW para 5.3.f "Stack Test" and para 5.3.g "External Fire Stack Test" of TB 700-2. The test report shall be submitted to the ARDC Safety Office to determine compliance with the requirements of para 3.5.3. The ARDC Safety Office has to be notified in sufficient time to allow witnessing of tests. Results to be presented IAW DI-H-1321A.

4.6. Design Freeze. All articles manufactured will be exactly the same as those submitted for First Article Testing. Any proposed change in design, materials, or packaging must be approved by the government prior to its incorporation.

NOTES:

6.2.1 Hazardous Materials. Hazardous materials/components will be identified as they are selected and submitted to the Procuring Contracting Officer for approval. Only energetic materials acceptable for DOD use will be utilized.

Materials forbidden for transport per Title 49, CFR, will not be utilized in the simulator.

6.7 Safety. This specification contains requirements which may necessitate the handling of hazardous materials and result in the manufacture of a hazardous item. It is emphasized that all applicable safety rules, procedures, and regulatory requirements be strictly followed during the handling, processing, and testing of the completed item and related hazardous materials.

6.8 Noise Protection. Hearing protection shall be used by contractor personnel during all functional testing.

Table I - First Article Inspection:

Explosive Hazard Classification	# Samples	Requirement	Inspection Method
Stack Test	15 boxes	3.5.3	4.5.10
External Fire	5 boxes	3.5.3	4.5.10
Safety			
Heat Flux Density	--	3.5.2.1	4.5.3.4
Fragmentation	--	3.5.2.2	4.5.3.5
RF Susceptibility (or EMR)	--	3.5.2.3	4.5.8.11
Electrostatic Susceptibility	--	3.5.2.4	4.5.8.12
Lightning Susceptibility	--	3.5.2.5	4.5.8.13

APPENDIX C

SAMPLE SOLICITATION REQUIREMENTS

SAMPLE A:

3.1.1.18 The contractor, as part of his proposal, shall submit a quality program plan and a summary description and listing of the safety and RAM history for all contracted items. As a minimum, this will include for each type of ammunition, (i.e. HE, Smoke, Illumination, Training).

a. Approximate total production to date of appropriate design

b. Total number of rounds fired

c. Number of safety failures

(1) Inbores

(2) Prematures (less than minimum arming distance)

(3) Short range (less than 80% of intended range)

c. Disposition of above safety failure investigations

e. Number of reported duds in relation to number of rounds fired

f. Number of reported earlies (fuze functioning outside three sigma standard deviations), in relation to number of rounds fired

g. Number of reported misfires in relation to number of rounds fired

The following is required for the weapon system in addition to each ammo type:

a. Description and results of safety tests which were conducted during R&D on the elements of the system.

b. Description and results of any environmental tests which were conducted on the hardware

c. Critical inspections conducted for acceptance of all hardware

d. Any available fault trees, hazard analysis or failure-mode analysis for the hardware

e. Inspection procedures and functional test for manufacturing of parts and assemblies

f. Ballistic acceptance criteria and test with representative results of test

The format for the above shall be in accordance with UDI-S-2327c or contractor equivalent.

3.2.26.3 The contractor must provide a Safety Assessment Report (SAR) to the US government before testing begins in accordance with DI-H-7049.

3.2.26.5 The contractor's proposal must include interim DOD and DOT hazard classifications for each foreign round and fuze. Prior to shipping any hardware to the US, the contractor must supply the US government with the following:

a. Nomenclature

b. Supplier and manufacturer

c. Drawings and specification

d. Packaging description

e. Purpose, performance and operation sequence

f. Weight of each type of explosive

g. Recommended classification

(1) DOD Hazard Class

(2) DOD Storage Compatibility Group

(3) DOT Hazard Class

(4) DOT Container Marking

h. Rationale for classification

3.2.26.6 Material Safety Data Sheets (MSDS) are required for hazardous material identification and material safety data and shall be forwarded to the US government.

3.3.1.7 All new fuzes must meet MIL-STD-1316C.

SAMPLE B:

1. Safety. The contractor shall compare the relative safety of each proposed alternative. The comparison shall be based, at a minimum, on the type and number of components used, the physical configuration and operational location, and ease of repair of the devices. The safety shall take into account the various environmental conditions to which the system may be exposed (e.g., vibration, temperature, humidity, sand, water, etc.).

The contractor shall identify critical hazards that are inherent in each alternative, and make recommendations to overcome or reduce these hazards. The safety effort shall be described in the Scientific and Technical progress reports, and documented as an independent section of the Final Scientific and Technical report.

2. Safety. The contractor shall investigate the optimum degree of safety within the constraints of operational effectiveness and detail the results in the Scientific and Technical progress reports.

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